The Veliger 44(1):99–107 (January 2, 2001)

THE VELIGER

NOTES, INFORMATION & NEWS

Non-Polar Components of Prey Sponge Extract Attract *Rostanga pulchra* (Nudibranchia: Doridacea)

Stacey Ong[1,2] and Brian K. Penney[2,3]*
[1] Department of Biology, University of Victoria, Victoria, British Columbia, V8W 2Y2, Canada, e-mail: stacey_ong@hotmail.com
[2] Bamfield Marine Station, Bamfield, British Columbia, V0R 1B0, Canada
[3] Department of Biological Sciences, University of Alberta, Edmonton, Alberta, T6G 2E9, Canada, e-mail: bpenney@ualberta.ca

Introduction

Opisthobranchs that lack the physical protection of a shell require other anti-predator defenses such as noxious chemicals or crypsis (Thompson, 1976). *Rostanga pulchra* MacFarland, 1905 mimics the color of its sponge prey almost perfectly by sequestering non-polar carotenoid pigments in the same proportions as found in several prey sponges (*Ophlitaspongia pennata, Esperiopsis originalis,* and *Plocamia karykina*; Anderson, 1971). Yet *R. pulchra* often moves between patches of sponge and feeds on several different species (Anderson, 1971); how does a slug find sponges containing the compounds needed for crypsis?

Many gastropods detect prey chemically (Sakata, 1989), and this capability is known for *R. pulchra* and some other dorid nudibranchs (Cook, 1962; Anderson, 1971; Elvin, 1976). It would seem adaptive if nudibranchs were attracted to prey via the same compounds they sequester. Indeed, the nudibranch *Tambja eliora* is attracted to tambjamines A and B, compounds it sequesters from its prey *Sessibugula translucens* (Carté & Faulkner, 1986). However, these compounds are fairly polar, whereas most nudibranch-sequestered compounds are non-polar (Avila, 1995) and relatively insoluble in water. Non-polar attractants are known for some herbivorous gastropods, but no attractive non-polar prey compounds are currently known for carnivorous gastropods (Kohn, 1961; Audesirk & Audesirk, 1985; Sakata, 1989).

Therefore, we used a Y-maze design to test whether *R. pulchra* is attracted to: (a) whole sponges, (b) sponge extracts (dissociated compounds), and (c) the non-polar fraction of sponge extracts, which includes carotenoids.

* Author for correspondence

Methods

Collections

Thirty *Rostanga pulchra* (4–15 mm in length) and several rocks with *Ophlitaspongia pennata* were collected intertidally or by SCUBA from Barkley Sound, British Columbia in October and November 1998, and kept in running natural seawater at Bamfield Marine Station. Nudibranchs were kept in individual mesh-sided containers upstream from rocks with sponges, and fasted for 6–18 days before being tested.

Extracts

Sponges were scraped from rocks and thrice extracted with three times volume of methanol for 24 hr each time. This extract was divided, half for the whole extract assays, and half for the non-polar extract assays. The latter half was extracted in a separatory funnel three times with an equal volume of hexane, and all three hexane portions combined as "non-polar extract." Both extracts were reduced to 2.5 mL in a rotary evaporator at ≤35°C. For the assays, whole extracts were contained in 7% agar blocks, but 8.5% agar was required for non-polar extracts and controls to solidify.

Y-Maze Assays

We assayed responses of *R. pulchra* in a Y-maze of clear, nonporous plexiglass (36 × 10 cm, with arms 21.5 × 10 cm). Flows were balanced between arms using dyes, and were equivalent for each test. Treatments (sponge, whole extract, non-polar extract) were randomly assigned to arms for each assay, and seawater run through the apparatus for several minutes, allowing compounds to diffuse. Nudibranchs were then placed in the middle of the Y-maze and allowed to crawl freely. We recorded a "choice" if the nudibranch progressed more than two body lengths into either arm, and "no choice" if it had not entered either arm after 30 min. After each trial, the Y-maze was emptied of water and scrubbed to remove mucus trails. Each nudibranch was tested once against sponges, whole extract, and non-polar extract sequentially; we feel this non-random order did not affect the significance of the results. For statistical analysis, we excluded "no choice" animals within each experiment, and used a contingency table (χ^2 test with continuity correction; Zar, 1984) to determine whether the stimulus position significantly affected the side of the Y-maze chosen by the slug.

Table 1

Responses of *Rostanga pulchra* to *Ophlitaspongia pennata* treatments in a Y-maze. Treatment vehicles were rocks for sponges and agar blocks for extracts; controls for each treatment were bare rocks or agar blocks with solvent only. Significant differences in slug position were tested via χ^2 tests with continuity correction. See Methods section for details.

Treatment	Stimulus position	Slug position		χ^2	P
		Left	Right		
Whole Sponge	Left	10	1	5.860	0.016
	Right	3	7		
Sponge Extract	Left	11	2	4.868	0.027
	Right	4	8		
Nonpolar Fraction	Left	12	0	7.106	0.008
	Right	4	6		

Results

Approximately 80% of the nudibranchs chose the treatment arm in each experiment. The stimulus position significantly affected which arm the slug chose (Table 1). The slugs also preferred the left arm of the maze, possibly due to slight differences in the flow rate. Allocation of treatments to each arm was roughly 50%.

Discussion

R. pulchra is attracted to whole *O. pennata,* confirming the results of Cook (1962) and Anderson (1971). In Anderson's assays, it is interesting that *R. pulchra* was not attracted to *E. originalis,* another prey sponge containing the correct mix of carotenoids; this may be due to the motivation of the animals, or the arena she used. *R. pulchra* also responds to isolated compounds from this sponge, suggesting that chemotaxis is an important means of prey location for this nudibranch. Further, it responds to non-polar compounds at a level equivalent to that for whole extracts; to our knowledge, this is the first report of non-polar attractants for a carnivorous gastropod. The attractive compounds are possibly the sequestered carotenoids, as another nudibranch is attracted to the more polar compounds sequestered from its prey (Carté & Faulkner, 1986). If *R. pulchra* is attracted to these highly insoluble carotenoids, it would suggest extreme adaptation to detect at a distance the compounds sequestered from prey.

Acknowledgments. We thank Richard Palmer for comments on this manuscript and for financial support (NSERC operating grant A7245), and David J. Arsenault for statistical advice and many useful comments. The Bamfield Marine Station Fall Program provided logistical support, and Shane Servant and Janice Weightman aided with collections.

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Pseudorhaphitoma kilburni (Mollusca: Gastropoda: Turridae), New Species from Yemen, Red Sea

Mauro Morassi
via Valverde 62, 25082 Botticino (BS), Italy; e-mail: mauro.morassi@iol.it
and
Antonio Bonfitto
Dipartimento di Biologia evoluzionistica e sperimentale, via Selmi 3, 40126 Bologna, Italy; e-mail: bonfitto@alma.unibo.it

Although the molluscan fauna of the Red Sea has been quite extensively investigated during more than two centuries, knowledge of the turrid fauna has remained rather poor. This work is intended to present the shells belonging to an unknown turrid species that have been sorted out from dredge samples collected during a marine survey in the Red Sea (Red Sed '92 European Community Project, September 1992, Gulf of Aden and South Red Sea, French oceanographic ship *Marion Dufresne*).

Almost all of the conchological characters of the present species are indicative of the mangeliine genus *Pseudorhaphitoma* Boettger, 1895; nevertheless, they are quite distinct from *Pseudorhaphitoma iodolabiata* (Hornung & Mermod, 1928), the only *Pseudorhaphitoma* previously known from the Red Sea, and those of any other de-